

Eco Char	Vital Sign Category	Monitoring Objectives	VS Id#	Vital Sign	Monitoring Question(s)	Monitoring Method	Metrics	Vital Sign Rank (0-5)	Comments / Notes
Physical / Chemical Conditions	Climate & Air Quality	Monitor visibility	P1	Visibility	Is sight distance, extinction, and quality reduced?	Aerosol filters, cameras	sight distance (extinction coefficient), particulate concentration, turbidity	2.9	
		Track rates of atmospheric deposition	P2	Atmospheric Deposition: Wet (direct & occult) and Dry	Document differences in Human vs. Volcanic vs. other natural sources	Station data	Total Hg & Hg concentration, Total N & N concentration, Total S & S concentration	2.1	
		Track atmospheric concentrations of particulates and gases, levels of radiation--emphasizing those with known human health or environmental impacts	P3	Atmospheric Gases: Climate Change Indicators, Human Pollutants, Natural-Volcanic	How are atmospheric gas concentrations changing and are these changes having ecological or human health impacts? How does volcanic activity influence air quality?	Station data	Air toxics concentration/human, CO2 concentration/climate change, NOx concentration/humans, O3 concentration/humans, S concentration/volcanic	2.2	
			P4	Marine Aerosols	How do marine aerosol levels vary over time and space?	station data	species, concentrations	1.4	
			P5	Atmospheric Particulates: Climate Change Indicators, Human Pollutants, Natural-Volcanic	How are atmospheric particulate species and concentrations changing and are these changes having ecological or human health impacts?	Station data	Dust, Particle analyses/species: 10-2.5-1 micron cuts, species	2.2	
			P6	Solar radiation	How are solar radiation inputs, UV-B, photosynthetically active radiation, or other wavelengths, fluxes changing?	UV-B monitoring (eg Brewer's), PAR sensors, total flux	upwelling / downwelling	2.7	
			P7	Weather & Climate	What are ranges of climate parameters within each park? Are they changing?	Weather stations (RAWS, COOP, NPS-ARD).	fog, wind, temperature, solar radiation, soil moisture, relative humidity, fuel moist/temp, wetness, precip (direct & occult)	3.4	
			P8	Extreme events (weather & ocean)	What are impacts of extreme events? How often do they occur, and at what intensity? What are temporal trends?	NOAA, USGS, NWS	hurricane extent/intensities, ENSO extent/intensities, etc	3.0	
		Identify and monitor spatial patterns of climate, such as trade-wind inversion elevation, lifting condensation level, lapse rates, etc.	P9	Climate Representations - 2- & 3- dimensional	Provide baseline data to help evaluate stability and variability in climate affecting natural populations, processes, and large scale ecological drivers?	modeling or mapping	Lifting condensation Level, Temperature lapse rates, Trade-Wind Inversion, Cloud patterns (incl. radiation)	1.7	
Soil, Water, & Nutrient Dynamics	P10	Monitor physical ocean dynamics--ocean currents, sea level, tides/swell	Ocean/Physical Dynamics: Currents, Sea Level, Tides/Swell	Is variation within normal range? What are temporal trends?	Tide Gauge, GIS, Buoy data, satellite data	bouy data, instrument data, Mapping velocity and direction, maximum signal wave height, satellite data, sea level, flood timing / magnitude, tide fluctuations	2.7		

## Intro, Monitoring goals & objectives, Conceptual Models, and Vital Signs

Also use main handout of review materials ([http://www.nature.nps.gov/im/units/pacn/monitoring/plan/vs04/review\\_materials.htm](http://www.nature.nps.gov/im/units/pacn/monitoring/plan/vs04/review_materials.htm))

Ecological Characteristic	Vital Sign Category		Monitoring Objectives
Human activities & cultural practices	Soundscapes		Monitor sound sources, frequencies, occurrence, and levels
	Viewscapes / Lightscapes		Monitor landscape / seascape appearance Monitor light levels and characteristics of light/dark cycles
	Land Use		Monitor points of entry for invasive species Monitor water use adjacent to or upstream from park boundaries Monitor land use adjacent to, or upstream of, park boundaries
	Park Use & Activities		Monitor debris-trash occurrence in coastal, riparian, wetland, and lacustrine habitats; in or near high use areas Monitor patterns of park visitation, use & damage (terrestrial & marine) Monitor incidence & occurrence of bioprospecting
	Management Zones		Monitor levels of take & harvest of harvested species (marine, freshwater, and terrestrial) or resources (coral, sand) Monitor patterns and effects of use and management Monitor effects of management practices on wilderness character
			Monitor visibility Track rates of atmospheric deposition Track atmospheric concentrations of particulates and gases, levels of radiation--emphasizing those with known human health or environmental impacts Monitor core weather/climate conditions within each park (on each island) Monitor frequency and intensity (severity) of extreme events (hurricanes, waves, winds, rain, etc.) Identify and monitor spatial patterns of climate, such as trade-wind inversion elevation, lifting condensation level, lapse rates, etc.
Physical / Chemical Environment	Climate & Air Quality		Monitor physical ocean dynamics--ocean currents, sea level, tides/swell Monitor cycles of nutrients and elements within soils and water--including carbonate (oceanic), nitrogen, and phosphorous Monitor soil erosion Monitor soil quality trends (physical, toxics/contaminants, other biologic and nutrients) Monitor condition and extent of soil crusts Monitor trends in surface water flow regimes Monitor wetland (incl. anchialine ponds) water flow exchange dynamics, size, and distribution Monitor ground water flow rates and direction of movement (recharge)
	Soil, Water, & Nutrient Dynamics		Monitor water quality core parameters Monitor supplemental water quality parameters Monitor microbiological water quality parameters Monitor toxic and contaminant levels in water Monitor biological invertebrate communities
	Water Quality		Monitor surface volcanic activity (lava flows, eruption events & ground deformation) Monitor volcanic & non-volcanic seismicity Monitor extent, location, and causes of mass wasting events (e.g. landslides)
	Geology	Hazards	Monitor shoreline dynamics Track dune locations and topography Identify and monitor the extent of permafrost Monitor karst and non-karst cave and lava tube habitat characteristics, topography, and extent
		Landforms	
Biotic Integrity	Terrestrial Ecosystems	Vegetation	Monitor patterns of distribution & extent of community types Monitor fire regimes and effect on vegetation Track insect and disease presence during forest dieback
			Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Consumers	Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Cave Systems Community Monitor changes in cave communities
		Freshwater Ecosystems	Producers Monitor community composition, structure, and productivity
			Community Monitor community dynamics, structure, function, and composition
			Monitor disease incidence and impacts, especially on native species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
	Marine Ecosystems	Benthic	Landscape Monitor patterns of distribution & extent of community types
			Community Monitor community dynamics, structure, function, and composition
			Population Track community and population trends in harvested fisheries / collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Community Monitor community dynamics, structure, function, and composition
		Water column (motile)	Track community and population trends in harvested fisheries species Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor occurrence of non-established (incipient) invasive species
			Community Monitor community dynamics, structure, function, and composition
			Track community and population trends in harvested fisheries collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
		Intertidal	Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species